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AUSTRALIA
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(Solving) an alchemical cipher in a shared notebook of John and Arthur Dee

Richard Bean (Uni of Qld, presenter), Sarah Lang (Uni Graz) and Megan Piorko (Science History Institute)

HistoCrypt 2022 (with introduction from HistoCrypt 2021)

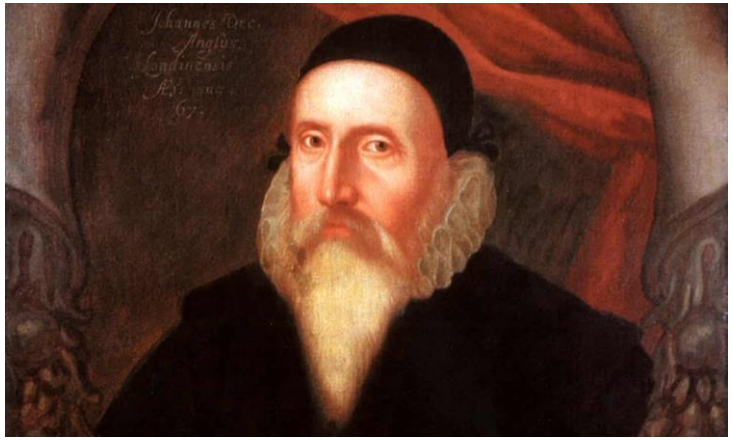
Monday 20 June 2022, 11:25am, Amsterdam Trippenhuis

The HistoCrypt 2021 paper

"An Alchemical Cipher in a Shared Notebook of John and Arthur Dee" (Sloane MS 1902) by Sarah Lang and Megan Piorko

Sloane Manuscripts at the British Library

Collection from Hans Sloane (1660-1753), a physician, who owned manuscripts of his scientific contemporaries such as John Dee (pictured)



John Dee famous English polymath (mathematician, alchemist etc)

Arthur Dee (1579-1651) physician to Tsar of Russia Michael I and King Charles I of England. Only one published book "Fasciculus Chemicus" – an anthology of alchemical writings.

The HistoCrypt 2021 paper

“An Alchemical Cipher in a Shared Notebook of John and Arthur Dee” (Sloane MS 1902) by Sarah Lang and Megan Piorko

Abstract

Alchemy, while being known for its secrecy, cryptographical and stylistic devices, isn’t known for its ciphers in particular.

However, ciphers can sometimes be found in alchemists’ and chymists’ (laboratory) notebooks.

A ciphertext and cipher table found in a shared notebook by John and Arthur Dee (Sloane MS 1902).

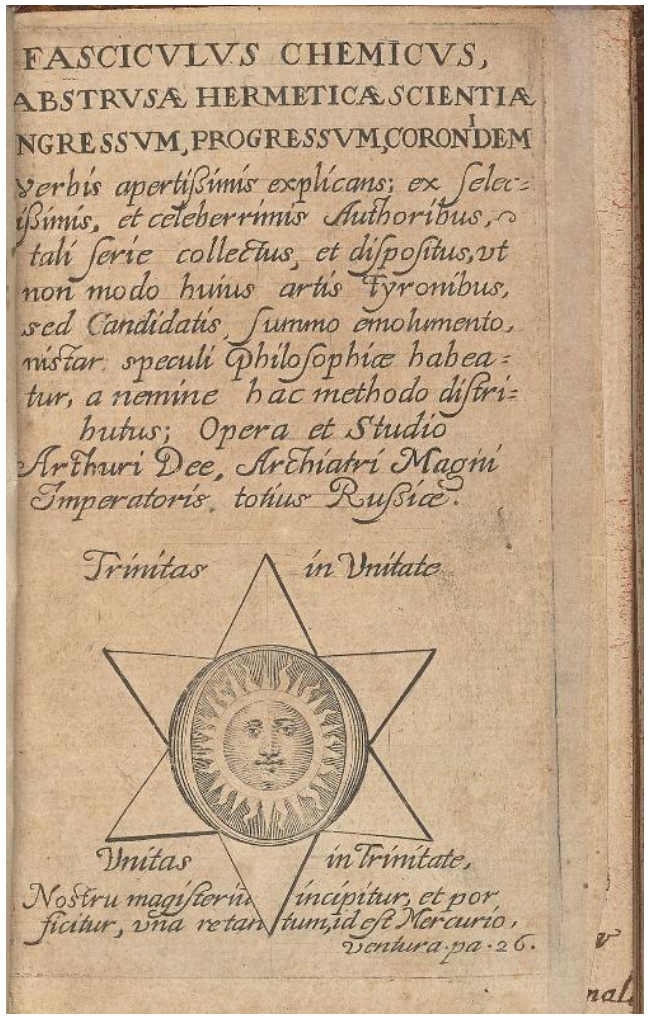
Amsterdam presentation 2019

At *“Embassy of the Free Mind” / Ritman Library Bibliotheca Philosophica Hermetica*

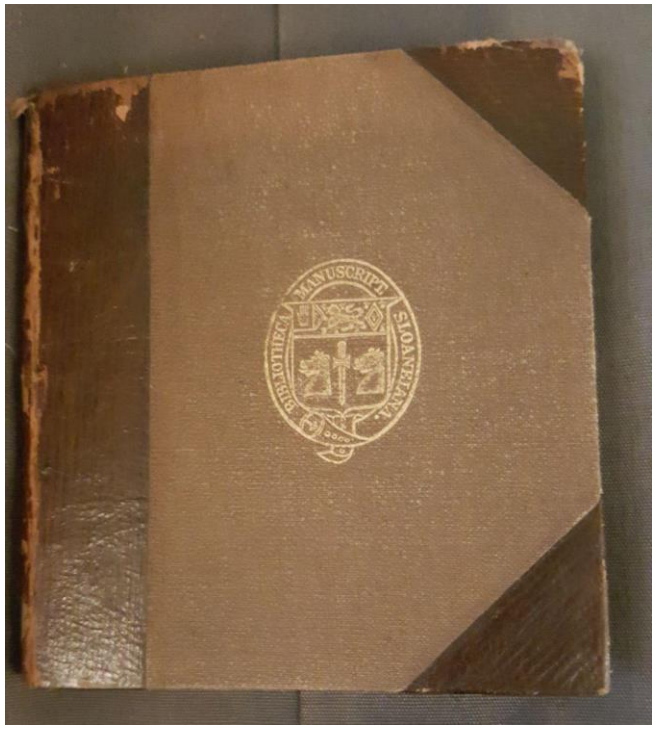
November 2019

“Rosicrucian Secrets” / Fasciculus Chemicus by Arthur Dee

This lecture by Megan Piorko will examine the multiple states of Arthur Dee’s sole publication, Fasciculus Chemicus (1631), but will concentrate on a rare version of which only a few copies exist today.



Sloane 1902: A shared notebook by John Dee and Arthur Dee

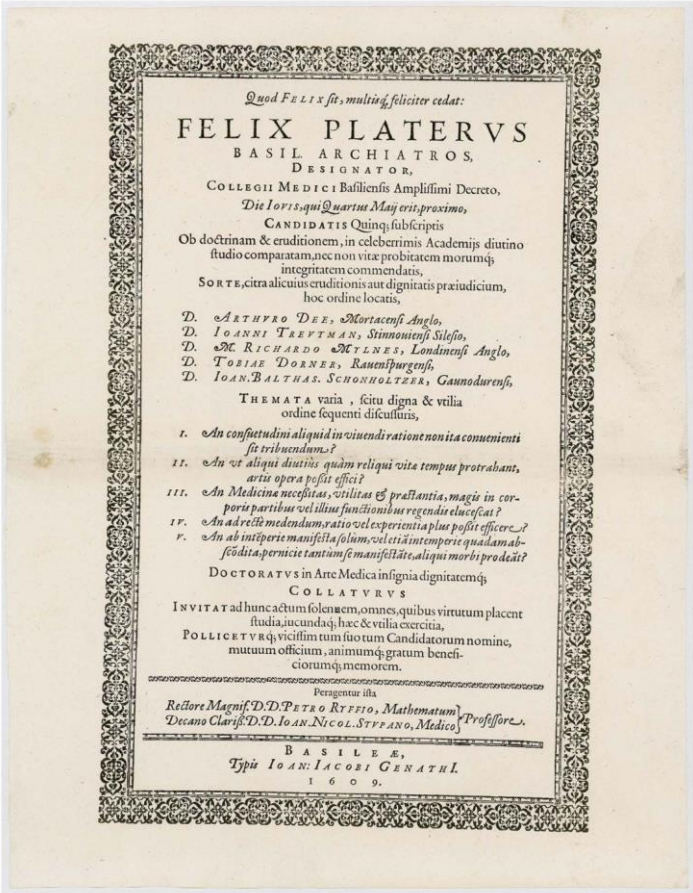


Paper and parchment, small manuscript bound in leather, 10cm x 12

31 folios numbered with Arabic numerals throughout

Folios 11v-14r, 27v, 28r, 29v are oriented upside-down from the rest of the codex

Arthur Dee, Physician to the Tsar



Quod FELIX sit, multisq; feliciter cedat:

FELIX PLATERVS
BASIL. ARCHIATROS,
DESIGNATOR,
COLLEGII MEDICI Basiliensis Amplissimi Decreto,
Die IOVIS, qui Quartus Maij erit, proximo,
CANDIDATIS Quinq; subscriptis
Ob doctrinam & eruditionem, in celeberrimis Academijs diutino studio comparatam, nec non vitæ probitatem morumq; integritatem commendatis,
SORTE, citra alicuius eruditionis aut dignitatis præiudicium, hoc ordine locatis,

D. ARTHVRO DEE, Mortacensi Anglo,
D. IOANNI TREVTMAN, Stinnouiensi Silesio,
D. M. RICHARDO MYLNES, Londinensi Anglo,
D. TOBIAE DORNER, Rauenspurgensi,
D. IOAN. BALTHAS. SCHONHOLTZER, Gaunodurensi,

THEMATA varia, scitu digna & vtilia ordine sequenti discussuris,

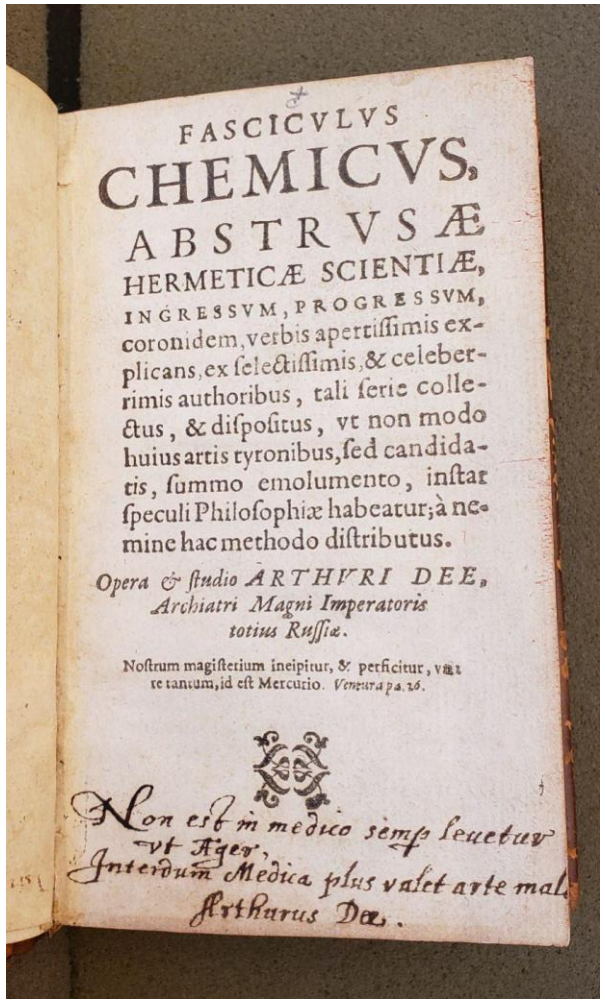
I. An consuetudini aliquid in viuendi ratione non ita conuenienti sit tribuendum?
II. An vt aliqui diutiùs quàm reliqui vitæ tempus protrahant, artis opera possit effici?
III. An Medicinæ necessitas, vtilitas & præstantia, magis in corporis partibus vel illius functionibus regendis elucescat?
IV. An ad rectè medendum, ratio vel experientia plus possit efficere?
V. An ab intẽperie manifesta solùm, vel etiã intemperie quadam abscõdita, pernicie tantùm se manifestãte, aliqui morbi prodeãt?

DOCTORATVS in Arte Medica insignia dignitatemq;
COLLATVRVS
INVITAT ad hunc actum solennem, omnes, quibus virtutum placent studia, iucundaq; hæc & vtilia exercitia,
POLLICETVRq; vicissim tum suo tum Candidatorum nomine, mutuum officium, animumq; gratum beneficiorumq; memorem.

Peragentur ista
Rectore Magnif. D.D. PETRO RYFFIO, Mathematum } Professore.
Decano Clariss. D.D. IOAN. NICOL. STVPANO, Medico }

BASILEÆ,
Typis IOAN: IACOBI GENATHI.
1609.

Medical Degree,
University of Basel, 1609



FASCICVLVS
CHEMICVS,
ABSTRVSÆ
HERMETICÆ SCIENTIÆ,
INGRESSVM, PROGRESSVM,
coronidem, verbis apertissimis explicans, ex selectissimis, & celeberrimis authoribus, tali serie collectus, & dispositus, vt non modo huius artis tyronibus, sed candidatis, summo emolumento, instar speculi Philosophiæ habeatur; à nemine hac methodo distributus.

Opera & studio ARTHVRI DEE,
Archiatri Magni Imperatoris
totius Russiæ.

Nostrum magisterium incipitur, & perficitur, vna re tantum, id est Mercurio. Ventura pa. 26.

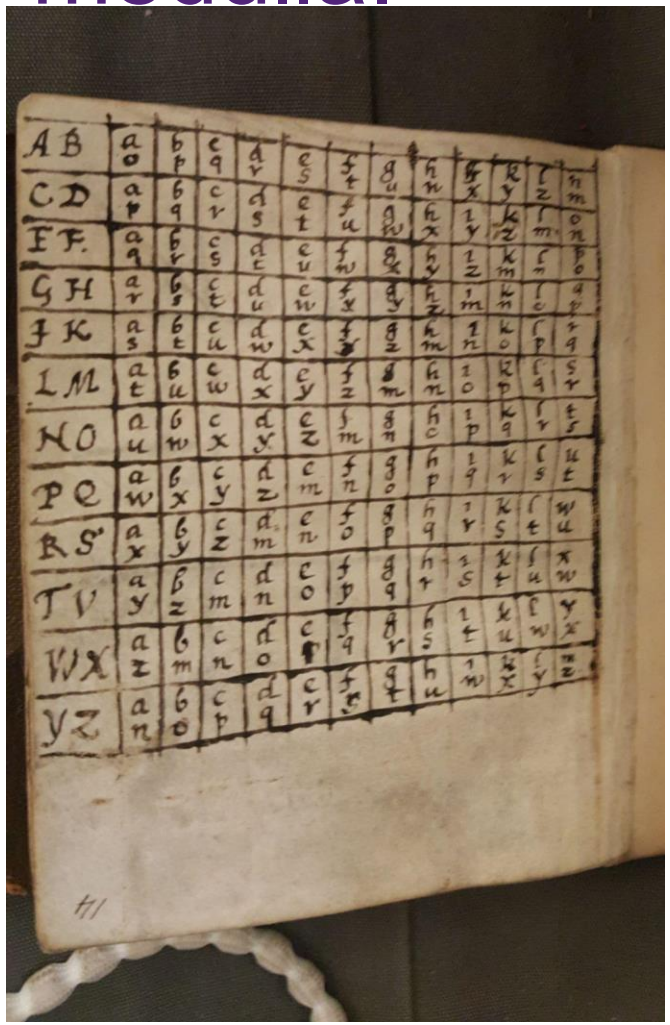
Non est in medico semp leuetur vt Ager,
Interdum Medica plus valet arte mal.
Arthurus Dee.

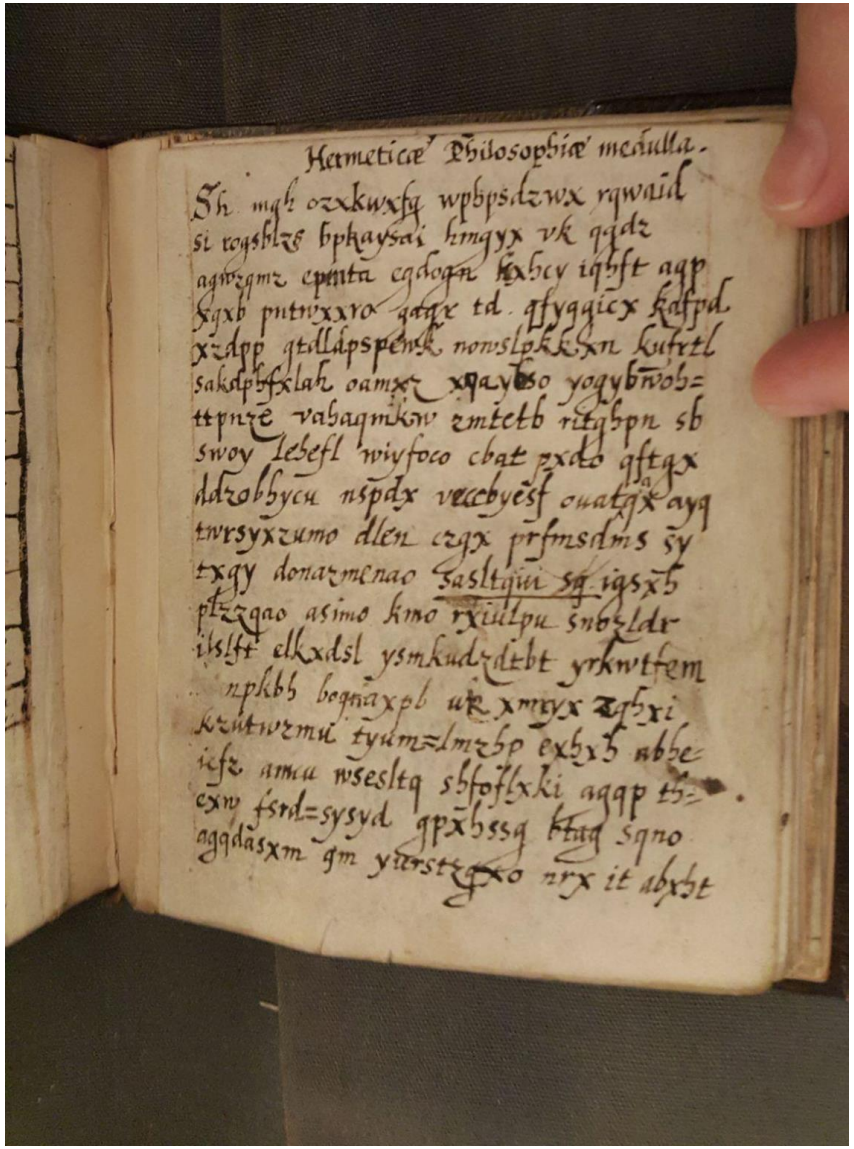
Fasciculus Chemicus, 1631

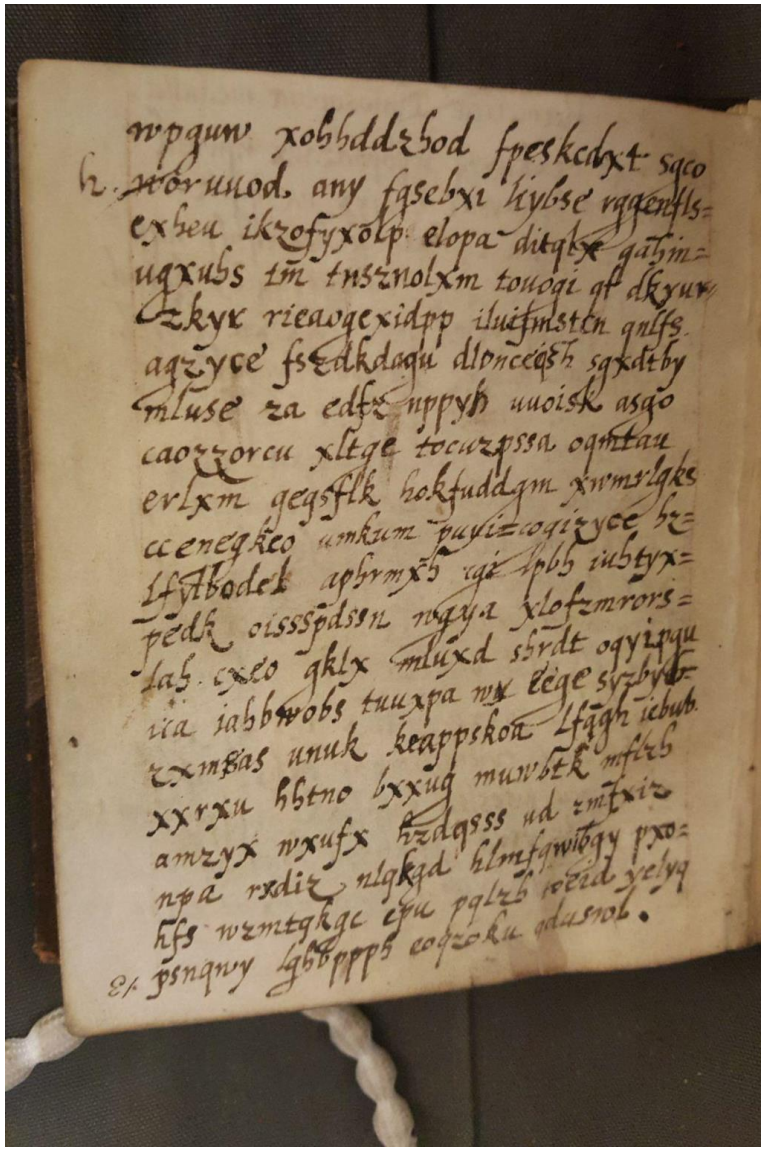
Tis not always in a physician's power to cure the sick; at times the disease is stronger than trained art

Ovid, Ex Ponto III. To Rufinus

Ciphertext and Table: “Hermeticae Philosophiae medulla.”







Traditional approach to breaking Porta ciphers

- **As for other periodic polyalphabetic ciphers**
  - Determine period length
  - Write text at various widths, and calculate average index of coincidence (Kasiski examination). Look for high value
  - Or, look for repeated substrings of reasonable length
- **There are some repeated 4-grams (if CT is correct)**
  - “sltq” (319, 454) – 135 apart
  - “phrm” (293, 833) – 540 apart
  - “wzmt” (196, 1047) – 851 apart
  - “zyce” (682, 817) – 135 apart
- **How long can a key reasonably be?**
- **Biermann – hill-climbing for Bellaso’s cipher challenge**

How hard is this supposed to be?

- **Kasiski examination doesn’t seem go well**
- **Could it be aperiodic polyalphabetic?**
- **Could it be based on words – as “zyce” occurs twice at end of words? Interrupted key Vigenere?**
- **Is the cipher table correct?**

Other ways of breaking Porta ciphers

- **If the cipher table is known, any PT letter can only map to 13 different CT letters**
- **So, a very long CT word should have only a few PT possibilities from a Latin dictionary**
- **The longer the word, the more likely there's only one corresponding Latin word**
- **Inputs**
  - Project Gutenberg Latin books
  - Perseus Digital Library
  - Arthur Dee's "Fasciculus Chemicus"

Other ways of breaking Porta ciphers

- **Longest word appears to be hyphenated “yogybnob=ttpnze” – 14 letters**
- **Guess language = Latin – assume spacing corresponds with plaintext, average word length 5.8 letters**
- **Attack**
  - Generate Latin hexagram statistics
  - Generate list of Latin words in decreasing order of frequency
  - find most common Latin words for each length, write out implied key; descending order of length

Most common Latin word for each PT word

yogybnobttpnze circumfodiebat rlwrncragwwyye
xlofzmrorslab multiplicatur wtgcggnlelrpg
uggenflsexbeu continuatione lpneiptlecarg
rieaogexidpp conversionem elratwccltwg
puyicogizyce laborantibus iptlecnwgtlc
ysmkudzdtbt distinguere ptntytliege
sakdpbfxlah consentiunt gcgewycctay
gtdldpspewk naturaliter nngtcepneip
bzlfylbodel perterritus cpncnnglggp
xobbddzbod deposuerat ntcaeipgcg
twrsyxzumo aedificium nictlctyre
ouataqxayq aesculapii cglipIteep
oissspdssn grammatica prlnnegtga
nonslpkkxn deditionem ttttrniglc
iubtyxpedk perficitur nggcepneip
iluifmstcn polypodium ngteteewlc
ikzofyxolp praesidium npytaenltg
hlmfqwibgy rusticorum ttncpnlgcy
gabmugxubs proverbium riatgwrynn

donazmenao tempestate gtcepneant
yurstzgxo medicinae ygctigntt
wpbpsdzwx latifolia welnawcat
ueccbyesf expositis glayieeta
tyumlmzbp magnopere pwccggpgw
tocuzpssa beneficio ltwgnngtc
tnsznolxm feliciter crpgwlrll
sbfoflxki curiosius gnylrpcwt
keappskoa prohibuit lacpniwln
hokfuddgm versantur ltpaptgcl
fszdkdagu plerosque tppciegcg
fsrdsysyd simplices atlypegne
fpeskcdxt sinistram anrtrictp
dlonceqsh suffundes etrplracw
dkyuuzkyx predictam ypniyttww
ddzobbycu praestare ycytilweg
ccenegkeo utriusque liaigyngt
caozzorcu publicate apacgyiig

Other key observations

Cipher	Plain	Key
tocuzpssa	beneficio	ltwgnngtc
rogsblzs	mercurii	ltwgnngt
ueccbyesf	consueuit	ltwgnngtc
ccenegkeo	quocunque	cltwgnngt
gtdldpspewk	naturaliter	nngtcepneip
iubtyxpedk	perficitur	nggcepneip
bpkaysai	partibus	cepneipt
donazmenao	tempestive	gtcepneiat
donazmenao	tempestiva	gtcepneiac

Table 2: Observed cipher / plain / key combinations.

Working backwards and forwards

- **Scoring Latin text using Latin hexagrams – can we pick key letters to maximize scores for implied PT? ...cltwgnngtcepneip...**

ccenegkeoumkumpu	-70.483930	quocunquegorbola
orxiulpusnozldri	-67.628624	amaterieimmersaq
ssytxgydonazmena	-65.398643	eabignetempestiu
xidppiluifmstcnq	-64.696493	ionemprestolarii
xueccbyesfouataq	-63.864914	iconsueuitmateri
eogklxmluxdsbrdt	-63.399216	siquodsolislucum
gxdtbymlusezaedf	-62.637591	ueniresoletettun
rxdiznlqkgdhlmfq	-61.828841	dentigratusproxi
etocuzpssaoqmtau	-61.331087	sbeneficiomisera
irogsblzsbpkaysa	-60.793256	xmercuriipartibu
xzdppgtdldpspewk	-55.970315	ignemnaturaliter
obxxugmuwbtkmflz	-55.765400	atamensempersupe

Final key

tlecnwgtlctppcwtgcggnlelrptwccltwgnngtcepneip

45 letters – a record key length

Is this really the key or has it been derived mathematically, from a word or phrase somehow? Placed in a 5x9 matrix?

Decrypting the cipher

- Bellaso / Della Porta Cipher
- cipher text, plain text, cipher table (*tabula recta*) and key (phrase, *clavis*)

key		a	b	c	d	e	f	g	h	i	k	l	m
AB	1	o	p	q	r	s	t	u	w	x	y	z	n
CD	2	p	q	r	s	t	u	w	x	y	z	n	o
EF	3	q	r	s	t	u	w	x	y	z	n	o	p
GH	4	r	s	t	u	w	x	y	z	n	o	p	q
IK	5	s	t	u	w	x	y	z	n	o	p	q	r
LM	6	t	u	w	x	y	z	n	o	p	q	r	s
NO	7	u	w	x	y	z	n	o	p	q	r	s	t
PQ	8	w	x	y	z	n	o	p	q	r	s	t	u
RS	9	x	y	z	n	o	p	q	r	s	t	u	w
TU	10	y	z	n	o	p	q	r	s	t	u	w	x

Keyphrase

sic alter iason aurea felici portabis uellera colcho

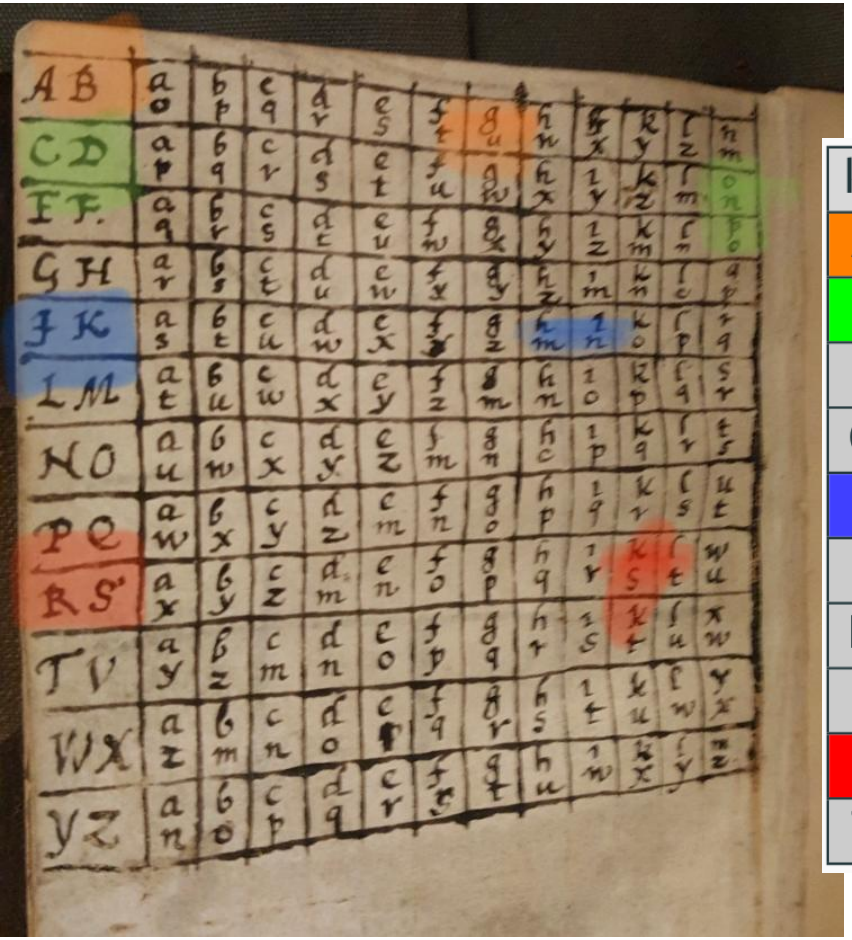
Ciphertext: Hermeticae Philosophiae medulla.

sh mgh ozxkwxfg wphpsdzwx rqwaid si rogsblzs bpkaysai hmgyx vk qqdz [...]

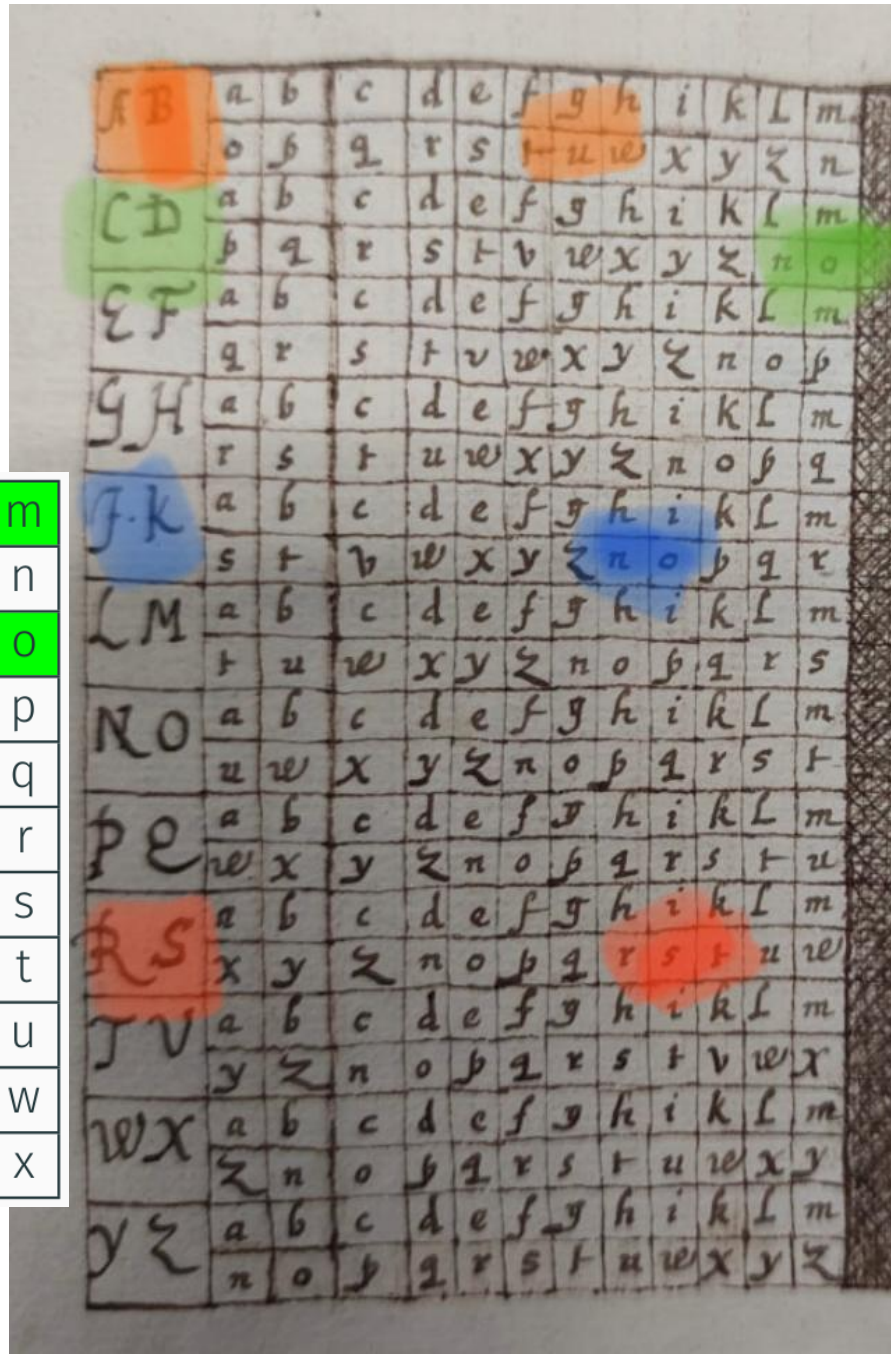
Solution = plain text

in ouo diaphano hermetice clauso ex mercurii partibus nouem

Irregularities in the *tabulae rectae*

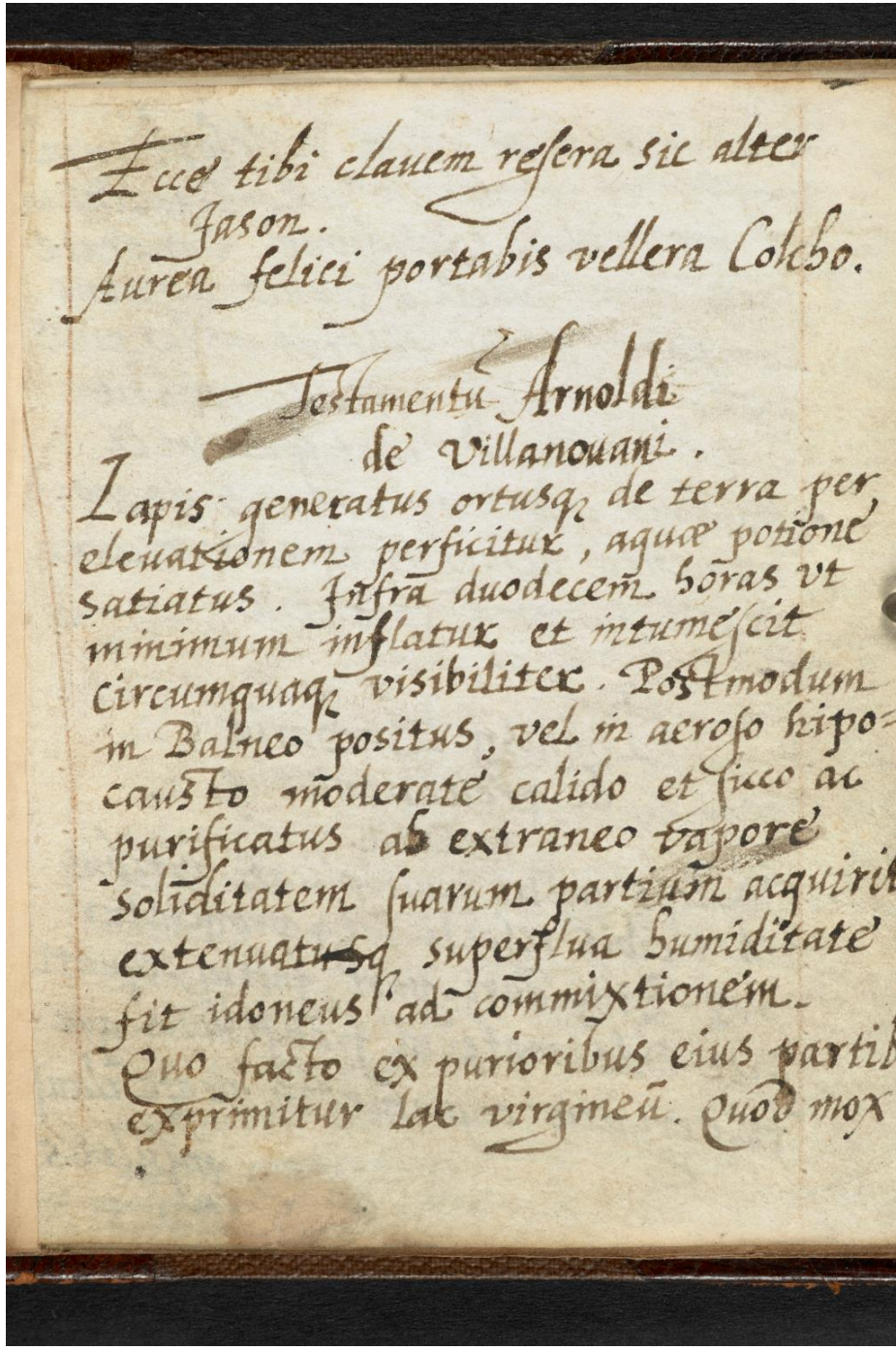


key		a	b	c	d	e	f	g	h	i	k	l	m
AB	1	o	p	q	r	s	t	u	w	x	y	z	n
CD	2	p	q	r	s	t	u	w	x	y	z	n	o
EF	3	q	r	s	t	u	w	x	y	z	n	o	p
GH	4	r	s	t	u	w	x	y	z	n	o	p	q
IK	5	s	t	u	w	x	y	z	n	o	p	q	r
LM	6	t	u	w	x	y	z	n	o	p	q	r	s
NO	7	u	w	x	y	z	n	o	p	q	r	s	t
PQ	8	w	x	y	z	n	o	p	q	r	s	t	u
RS	9	x	y	z	n	o	p	q	r	s	t	u	w
TU	10	y	z	n	o	p	q	r	s	t	u	w	x

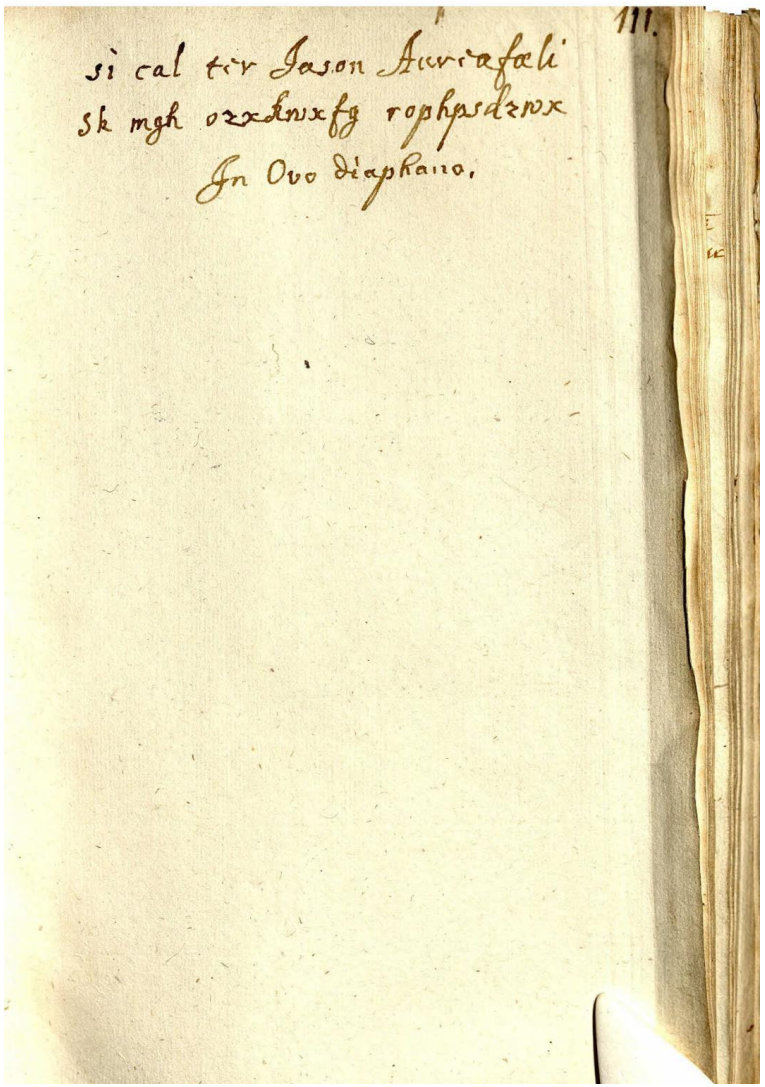


The recipe translated

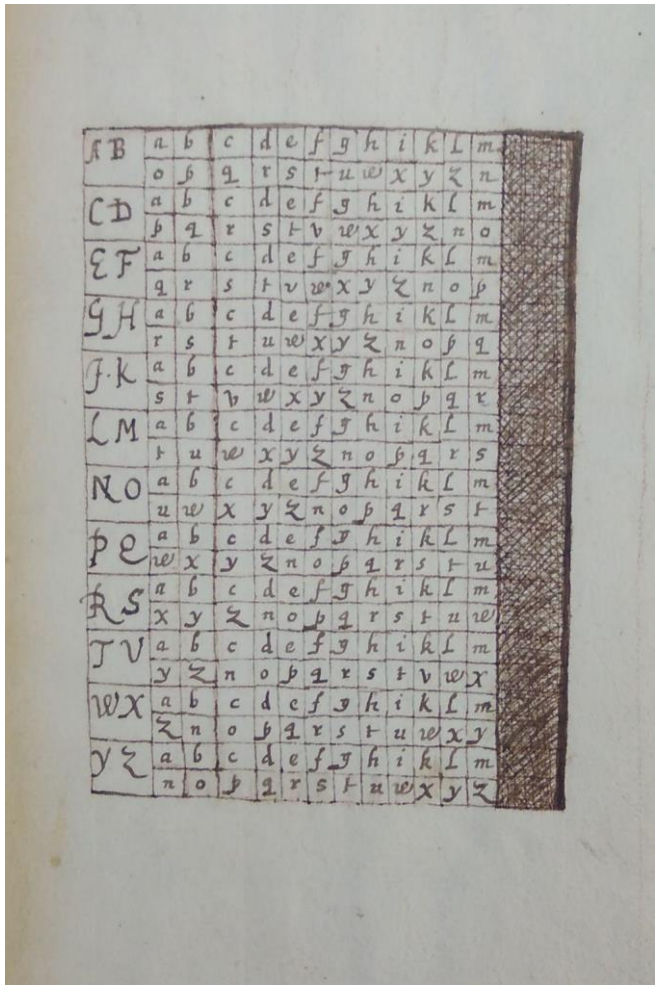
- **177-word passage, 45-letter password**
- **Instructions seemingly from towards the end of a recipe for making the philosopher's stone**
- **Followed by the key (adapted from Augurelli's *Chrysopoeia*)**
- **In a different MS, the plaintext was found followed by more practical instructions**
- **With it came lab notes indicating somebody tried it out**
- **Is it a practical recipe?**
  Where's the beginning?
- **Potential connection to the *Processus Universalis* recipe group?**

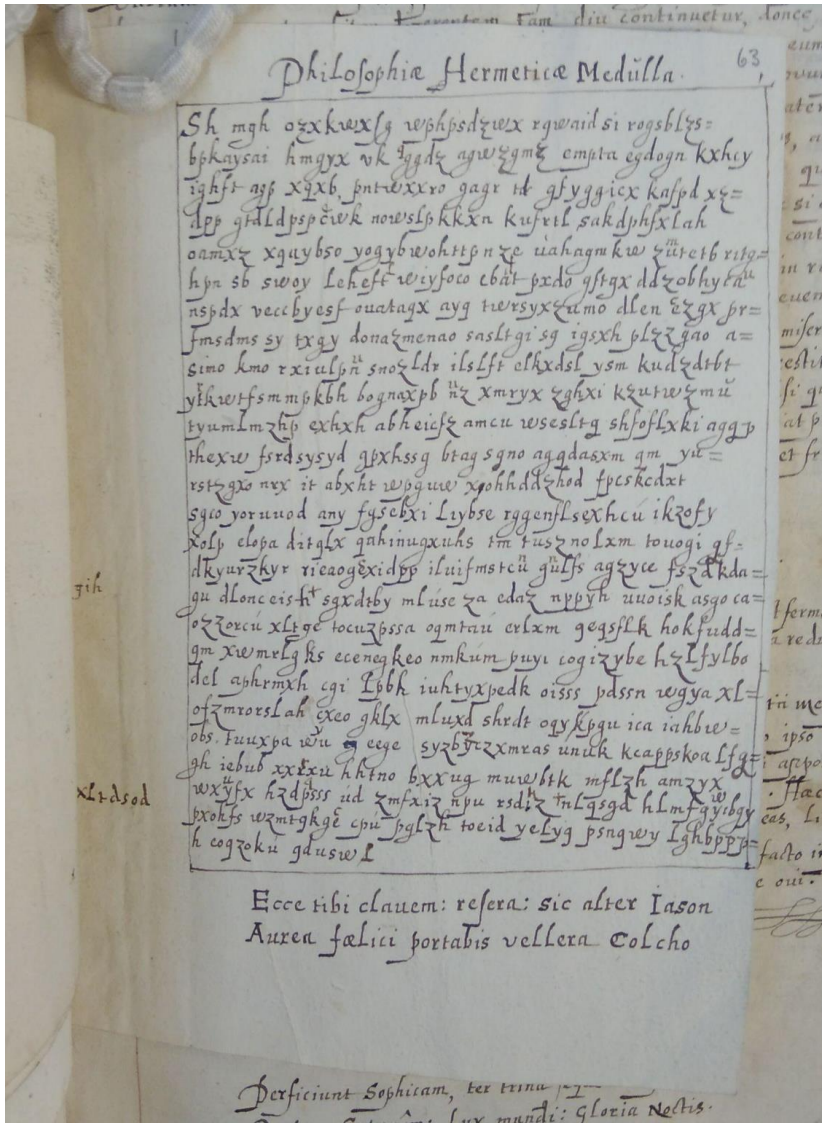


Alchemical Scribal Networks: MS Ashmole 1423



Alchemical Scribal Networks: Edinburgh MS Dc.1.30

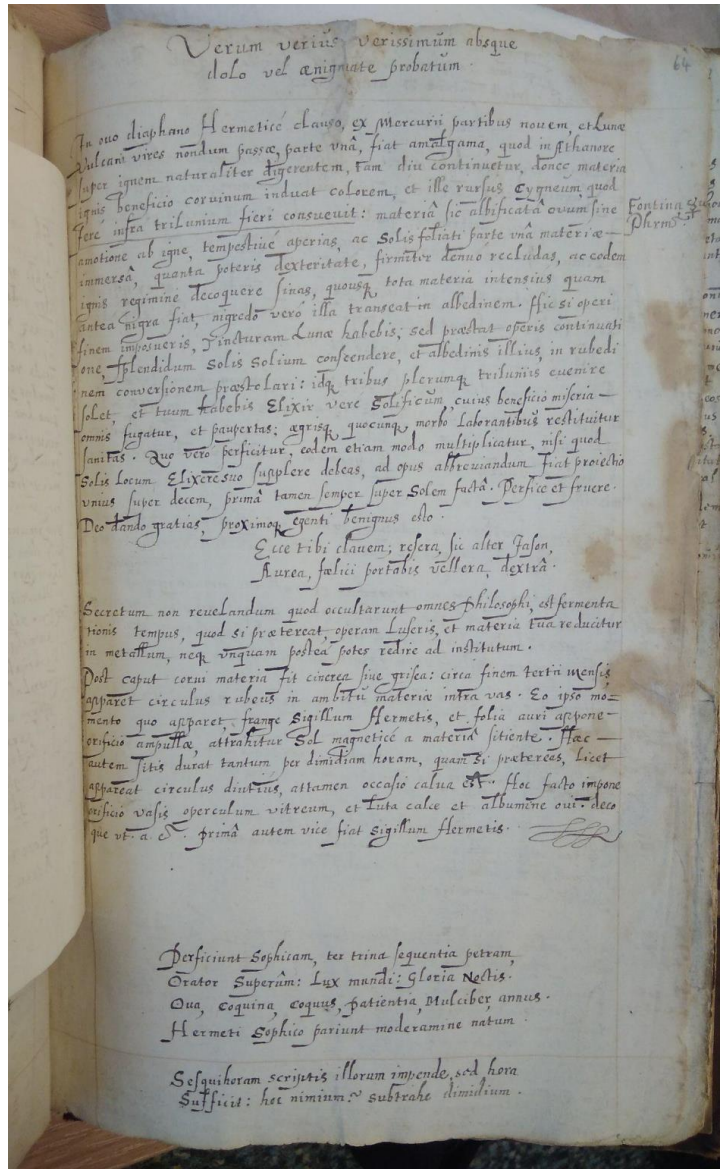




Philosophiæ Hermeticæ Medulla. 63

Ecce tibi clauem: resera: sic alter Iason
Aurea fœlici portabis vellera Colcho

Perficiunt Sophicam, ter trina sequentia petram,
Orator Superum: Lux mundi: Gloria Nectis.



Verum verius verissimum absque
dolo vel ænigmate probatum. 64

In quo diaphano Hermetice clauso, ex Mercurii partibus nouem, et Lunæ
vulcani vires nondum passæ, parte vnâ, fiat amalgama, quod in sthanore
super ignem naturaliter ingerentem, tam diu continuetur, donec materia
ignis beneficio coruinum induat colorem, et ille russus Cygneum quod
fere infra triuium fieri consueuit: materiâ sic albificatâ ouum sine Fontina
amotione ab igne, tempestiuè apering, ac Solis foliati parte vnâ materiæ
immersâ, quanta poteris dexteritate, firmitèr denuo recludas, ac eodem
ignis regimine decoquere stinas, quousq; tota materia intensius quam
antea nigra fiat, nigredo verò illa transeat in albedinem. Hic si operi
finem imposueris, Pinturam Lunæ habebis; sed præstat operis continuati
one splendidum Solis Solium conscendere, et albedinis illius, in rubedi
nem conversionem præstolari: idq; tribus plerumq; triuiis euenire
solet. et tum habebis Elixir vere Solificum, cuius beneficio miseria
omnis fugatur, et pauertas; egritq; quecunq; morbo laborantibus restituitur
sanitas. Quo vero perficitur, eodem etiam modo multiplicatur, nisi quod
Solis locum Elixir esto supplere deleas, ad opus abbreuiandum fiat proiectio
vnius super decem, prima tamen semper super Solem factâ. Perfice et fruere.
Deo dando gratias, proximoq; egenti benignus esto.

Ecce tibi clauem; resera, sic alter Iason,
Aurea fœlici portabis vellera, dextrâ.

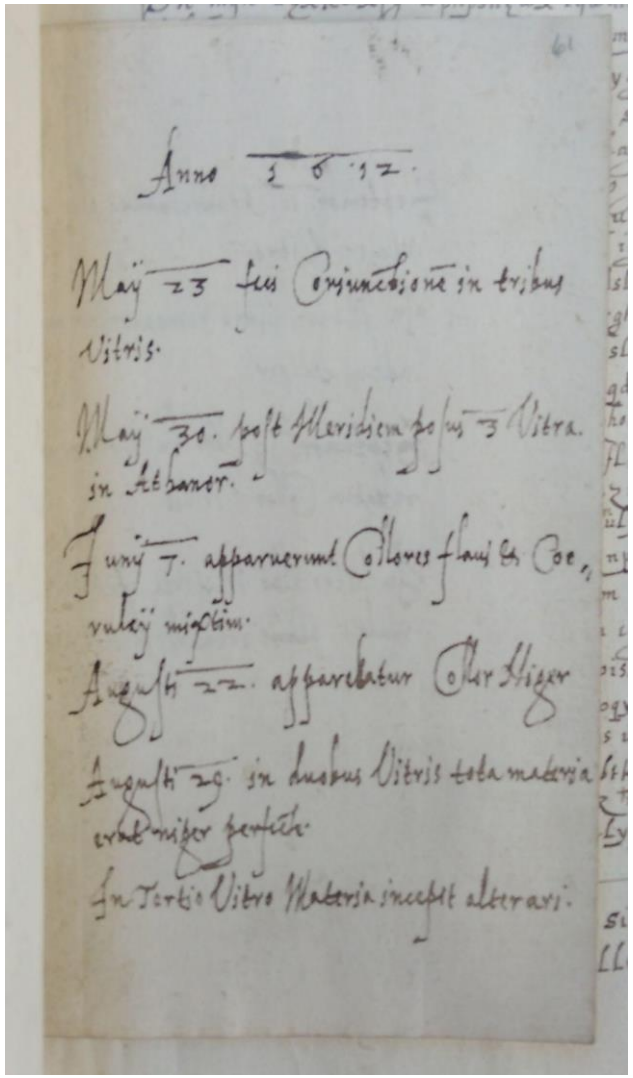
Secretum non reuelandum quod occultarunt omnes Philosophi, est fermenta
tionis tempus, quod si prætereat, operam Luseris, et materia tua reducitur
in metallum, neq; vnquam postea potes redire ad institutum.

Post caput cerui materia sit cinerea siue grisea: circa finem tertij mensis
apparet circulus rubeus in ambitu materiæ infra vas. Eo ipso mo
mento quo apparet, frange Sigillum Hermetis, et folia auri appone
orificio ampullæ, attrahitur Sol magneticè a materiâ sitiente. Hæc
tamen sitis durat tantum per dimidium horam, quam si præteres, licet
appareat circulus diutius, attamen occasio calua erit. Hoc facto impone
vasis operculum vitreum, et tuta calce et albumine ouj deco
que vt a. prima autem vice fiat Sigillum Hermetis.

Perficiunt Sophicam, ter trina sequentia petram,
Orator Superum: Lux mundi: Gloria Nectis.
Qua, coquina, coquus, patientia, Vulcanus annus.
Hermeti Sophico pariunt moderamine natum.

Sesquiheram scriptis illorum impende, sed hora
Sufficit: hec nimium subtrahe dimidium.

Lab notes on the process (in MS Dc.1.30)



Anno 1 6 12.

Maij 23 feci Coniunctione in tribus Vitris.

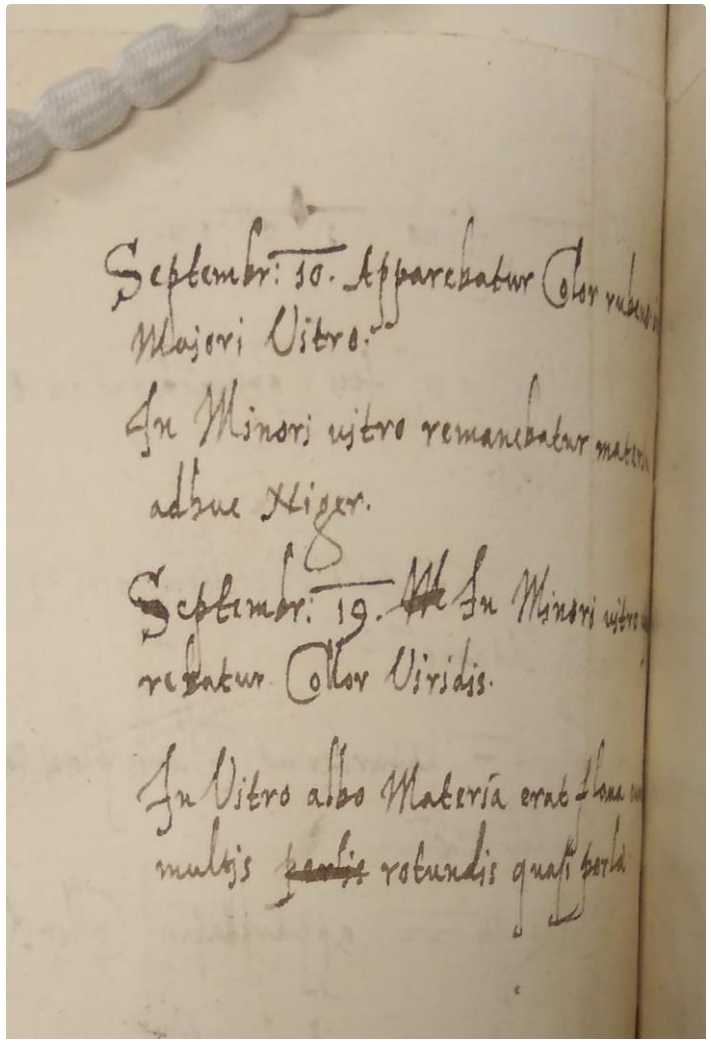
Maij 30. post Meridiem posui 3 Vitra in Athanor.

Junij 7. apparuerunt Collores flavi & Coeruleij mixtim.

Augusti 22. apparebatur Color Niger

Augusti 29. in duobus Vitris tota materia erat niger perfecte.

In Tertio Vitro Materia incepit alterari.



Septembr: 10. Apparebatur Color rubeus in Majori Vitro.

In Minori vitro remanebatur materia adhuc Niger.

Septembr: 19. ~~M~~ In Minori vitro apparebatur Color Viridis.

In Vitro albo Materia erat flava cum multis ~~perlis~~ rotundis quasi perlis

Media interest

Deciphering the Philosophers' Stone: how we cracked a 400-year-old alchemical cipher

Published: October 13, 2021 1.06am BST

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What secret alchemical knowledge could be so important it required sophisticated encryption?

The setting was Amsterdam, 2019. A conference organised by the Society for the History of Alchemy and Chemistry had just concluded at the Embassy of the Free Mind, in a lecture hall opened by historical-fiction author Dan Brown.

At the conference, Science History Institute Postdoctoral Researcher Megan Piorko presented a curious manuscript belonging to English alchemists John Dee (1527–1608) and his son Arthur Dee (1579–1651). In the pre-modern world, alchemy was a means to understand nature through ancient secret knowledge and chemical experiment.

Authors

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Allington Postdoctoral Fellow, Science History Institute, Georgia State University

Sarah Lang
PostDoc in Digital Humanities at Centre of Information Modelling (University of Graz), University of Graz

Disclosure statement

Megan Piorko receives funding from the Science History Institute.

How Scholars Cracked a Medieval Alchemist's Secret Code

Written in a puzzling Latin cipher, it contains his formula for eternal life.

BY SARAH DURN • NOVEMBER 11, 2021

This 1618 engraving by Matthaeus Merian the Elder depicts the alchemical universe with the Philosopher's Stone at its center. FOTOTECA STORICA NAZIONALE/CONTRIBUTOR/GETTY IMAGES

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IN SUMMER 2018, MEGAN PIORKO was deep into research for her doctoral dissertation on 16th- and 17th-century alchemist and physician Arthur Dee. On a beautiful London day, she called up a little-studied alchemical notebook from the archives of the British Library, Sloane MS 1902. Immediately, Piorko was intrigued. The notebook, to which

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